FORTY-FIRST ANNUAL REPORT

OF THE

1 MAY 1931
INSTITUTE

Agricultural Experiment Station

OF THE

University of Kentucky

FOR THE YEAR 1928

Part II

Bulletins 283-290

Circulars 39 and 40

25/C

IMPERIAL BUREAU
9 NOV. 1929
OF MYCOLOGY

FORTY-FIRST ANNUAL REPORT

OF THE

Agricultural Experiment Station

OF THE

University of Kentucky

FOR THE YEAR 1928

Part I.

Report of the Director

Meteorological Summaries

UNIVERSITY OF KENTUCKY

Lexington, Ky.

Board of Trustees

Hon. Flem D. Sampson, Governor, Chairman, *ex officio*
W. C. Bell, Superintendent of Public Instruction, *ex officio*
Newton Bright, Commissioner of Agriculture, *ex officio*
J. M. Finch, Helena, Mason County
R. J. Bassett, Leitchfield, Grayson County
H. M. Froman, Lexington, Fayette County
Joe B. Andrews, Covington, Kenton County
Robert G. Gordon, Louisville, Jefferson County
Richard C. Stoll, Lexington, Fayette County
James W. Turner, Paintsville, Johnson County
W. J. Webb, Mayfield, Graves County
Louis E. Hillenmeyer, Lexington, Fayette County
E. B. Webb, Lexington, Fayette County
James Park, Lexington, Fayette County

EXPERIMENT STATION STAFF

BOARD OF CONTROL

Richard C. Stoll, Chairman, Lexington, Ky.
H. M. Froman, Lexington, Ky.
R. G. Gordon, Louisville, Ky.
James Park, Lexington, Ky.
J. B. Andrews, Newport, Ky.

Frank L. McVey, President

Thomas P. Cooper, Dean and Director

ADMINISTRATION

Thomas P. Cooper, Director
D. H. Peak, Business Agent
O. L. Ginocchio, Secretary

AGRONOMY

George Roberts, Head
E. J. Kinney, Assoc. Agronomist
P. E. Karraker, Asst. Agronomist
J. F. Freeman, Asst. Agronomist
W. D. Valleau, Plant Pathologist
E. N. Fergus, Asst. Agronomist
J. B. Kelley, Agricultural Engineer
E. M. Johnson, Asst. Plant Pathologist

ANIMAL HUSBANDRY GROUP

E. S. Good, Chairman
W. S. Anderson, Horses
E. J. Wilford, Swine, Meats
W. J. Harris, Beef Cattle
J. Holmes Martin, Poultry
C. J. Maupin, Poultry Improvement
Fordyce Ely, Dairy Husbandry
W. C. Eskew, Cream Grading
George Insko, Cream Grading
J. W. Nutter, Dairyman
Amanda Harms, Asst. Path. Bact.
G. D. Buckner, Animal Nutrition
W. M. Insko, Jr., Animal Nutrition
Harold Barber, Head Herdsman

ANIMAL PATHOLOGY

W. W. Dimock, Head
Philip R. Edwards, Bacteriologist
F. E. Hull, Asst. Veterinarian

CHEMISTRY

J. S. McHargue, Acting Head
A. M. Peter, Chemist
S. D. Averitt, Chemist
O. M. Shedd, Chemist
D. J. Healy, Bacteriologist
W. R. Roy, Asst. Chemist

CREAMERY LICENSE SECTION

J. D. Foster, Inspector, in Charge
N. J. Howard, Inspector

ENTOMOLOGY AND BOTANY

H. Garman, Head
Mary L. Didlake, Asst. Entomologist
H. H. Jewett, Research Asst. Entgst.
Jessie Terry, Seed Analyst
Lucille Dobbins, Seed Analyst
Eugene Simpson, Inspector

FARM ECONOMICS

W. D. Nicholls, Head
W. G. Finn, Farm Management
W. L. Rouse, Farm Management
R. E. Proctor, Farm Management
Z. L. Galloway, Farm Organization
Merton Oyler, Rural Life Studies

FEED CONTROL

J. D. Turner, Head
H. D. Spears, Chemist
W. G. Terrell, Inspector
Fred Fitschen, Inspector
L. V. Amburgey, Microscopist

FERTILIZER CONTROL

H. E. Curtis, Head
Harry Allen, Chemist
Lelah Gault, Asst. Chemist
Robert Mathews, Inspector

HOME ECONOMICS

Mariel Hopkins, Head
Statie Erikson, Assistant

HORTICULTURE

A. J. Olney, Acting Head
C. S. Waltman, Assistant
E. M. Emmert, Assistant

MARKETS AND RURAL FINANCE

Dana G. Card, Marketing
E. C. Johnson, Marketing
C. D. Phillips, Marketing

PUBLIC SERVICE LABORATORY

L. A. Brown, Head
A. L. Meader, Asst. Chemist
James H. Martin, Asst. Chemist
E. K. Borman, Bacteriologist
W. B. Hamilton, Asst. Bacteriologist

ROBINSON SUBSTATION
(Quicksand, Ky.)

R. W. Jones, Superintendent
C. H. Burrage, Forester
Lula Hale, Field Worker

WESTERN KY. SUBSTATION
(Princeton, Ky.)

S. J. Lowry, Superintendent
L. M. Caldwell, Assistant

LETTER OF TRANSMITTAL

To His Excellency, Hon. Flem D. Sampson, Governor of Kentucky:

Sir:—In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862," I herewith submit the Forty-first Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, *Director.*

January 1, 1929.

ANNUAL REPORT

of the

DIRECTOR OF THE

KENTUCKY AGRICULTURAL EXPERIMENT STATION

For the Year 1928

Agricultural experiment stations were established by the state and federal governments to conduct research, carry on experiments and promote scientific investigation in the field of agriculture. Consequently, the work of the Experiment Station is closely linked with the agriculture of the state, particularly with those activities that result in the creation of new wealth from the farm. Adequate support of research in the field of agriculture is fundamental to a progressive and growing agriculture. It is likewise essential to the program of agricultural education thru school and extension work. Changes in the agricultural situation and in agricultural needs are occurring so rapidly and are often of such great importance that there is increased need of research.

Evidence is constantly accumulating at the Kentucky Experiment Station that many farmers desire to make greater use of the results of research. This point may be illustrated from the results following a prolonged study of the cause and diagnosis of infectious abortion in cows, a research project referred to in previous annual reports. It was found that through the development of antigens from different strains of the causal organism (*Bact. abortus* Bang) used individually, or in certain combinations, the diagnostician is enabled to determine more accurately those animals that are infected. Dairymen recognized the value of a more accurate method

of diagnosis of infectious abortion in cows, and increased demands were made upon the Experiment Station to indicate those cows infected with the disease. Eighteen hundred tests were made for dairymen during the year as a part of the research study. The conduct of the tests was later made self-sustaining by requiring a small payment for the service. Tho a charge is made for the work, dairymen have been so desirous of taking advantage of the method that requests for tests are now being made at the rate of five thousand a year.

Much attention has been given by the Kentucky Experiment Station to research in the economic field of agriculture. A number of projects are vigorously prosecuted with the expectation of formulating information that may enable the farmer to better adjust and determine his economic relationships. Various projects concerned with farm organization and farm management have been conducted for several years and are now yielding important results. Information has been accumulated in these fields from every important agricultural region of the state. It gives a basis for determining various programs that relate to the economic relations and provides the individual farmer with the fundamental information necessary for better farm management.

Fundamental research in agriculture is of great importance to the farmer. However, his interest is most definite in work that contributes to the betterment of farm or livestock practices and methods or to the development of superior varieties of crops and methods of control of diseases and insect pests. Consequently, a large part of the resources of the Experiment Station is devoted to studies which may improve practices and crops or lead to the discovery of methods of control that will result in greater returns to the farmer.

The two experiment substations established at Princeton and Quicksand, respectively, have shown very satisfactory progress. An outstanding development of the Western Kentucky Substation at Princeton, has been the successful production of pastures. Soil so reduced in fertility that less than five bushels of corn could be produced per acre, was built

up to such an extent, by the application of one and one-half tons of ground limestone and six hundred pounds of superphosphate per acre, to a degree that excellent pasture is provided. The cost of the materials applied was approximately ten dollars per acre, but the treatment may be expected to last, for pastures, for eight or ten years. Sweet clover, orchard grass and lespedeza were the chief grass seeds used in the mixture seeded. Experiments have been begun to determine the average production of beef per acre on these pastures. However, the chief importance of the work lies in demonstrating an effective method of soil restoration. An adoption of such practice by western Kentucky farmers will add greatly to the wealth production of the region, for the building up of good pastures later means a greater crop producing capacity. A large amount of work has been organized in horticulture and in poultry production. Increasing emphasis will be given to experimental work at this substation. Approximately 59 acres have been added to the farm by purchase during the year. The Western Kentucky Substation now comprises 519 acres. The people of Caldwell County gave 400 acres and 119 acres have been purchased from the income of the substation.

The Robinson Substation in eastern Kentucky is proving of increasing interest to the mountain section. Its main activity is forest management with the object of determining the method or methods of management that may bring about an economical production of timber on cut over lands. It is estimated that approximately nine million acres of the state represent potentially valuable timber producing areas. The rate of reproduction and rapidity of growth of the valuable species is encouraging to the future prospect for timber. Stands of poplar six to seven years old are now twelve to twenty-two feet high. The results secured from the experiment will have a wide application.

The most difficult problem in connection with the operation of the forest is that of fire prevention. Numerous fires, some from natural causes, but many of incendiary origin, have occurred. During the past two years, the area burned and showing severe damage has been relatively small. However,

the expense of operation and of care of the property is much increased by the necessity of fighting fire and of its prevention.

Farm and livestock operations at the Robinson Substation are primarily designed to demonstrate some advantageous agricultural practice that will illustrate the possibilities of mountain farms.

The annual report of the research and various other activities of the Experiment Station is necessarily brief and incomplete. Bulletins and scientific papers presented from year to year carry the results of research in progress. These publications are sent free to citizens of the state upon request.

The operations under the commercial fertilizer law, the commercial feeding stuffs act, the nursery inspection law, the creamery license act, and similar regulatory and service functions, have an important bearing upon the research program of the Experiment Station. New problems are frequently discovered and the contacts with the industries affected by these acts enable the Experiment Station to give a greater service to agriculture in addition to the protection that is afforded the individual.

Agricultural Credit and Finance. A study has been conducted for the past two years of the facilities for agricultural credit in the state and extent to which agriculture is financed. From the standpoint of long term mortgage credit, the farmers of Kentucky seem adequately financed. Kentucky farmers are using a large amount of such credit, as evidenced by the farm mortgage debt. From a study of the amount of farm mortgage loans made by various institutions, it was estimated that the total farm mortgage debt in Kentucky on December 31, 1926, was $122,584,513. The estimate of sources of this credit was as follows:

State banks and trust companies	$30,786,000
Life insurance companies	25,500,000
Federal Land Bank	24,164,133
Private investors and other agencies	24,517,000
Joint stock land banks	11,882,380
National banks	5,735,000
	$122,584,513

These institutions are supplementary to some extent in their operations in the state. Thus, the Federal Land Bank has made a large share of its loans on farms which may be called average size farms. Joint stock land banks and life insurance companies, on the other hand, have made a greater part of their loans on larger farms and also tend to confine their loans to the better agricultural regions. State and national banks on the average make smaller loans, taking care of small farms and the small farm mortgage loans of some larger farms. The rate of interest on loans is from 5 to 6 percent. Land banks and some insurance companies make loans on a long term amortization plan, which is an advantage to the borrower and prevents frequent and expensive renewals of mortgages.

There have been many foreclosures of farm mortgages in Kentucky, especially in the western part of the state, since 1921. A study of 144 farms on which the Federal Land Bank and the joint stock land banks in Kentucky had made foreclosures shows that the inflation of land prices followed by deflation is an important cause leading to foreclosure. Fifty-five percent of these farms were purchases during the years of high prices of land, 1918-1920. Following 1920, with the fall in prices of agricultural products, incomes on farms were greatly reduced and land values dropped. Many farmers were unable to meet the interest payments on mortgages and creditors were forced to foreclose.

An analysis of short term loans to farmers by state and national banks from reports received from 77 banks in Kentucky, showed that three-fourths of the short term farm loans were made for periods of 3 to 6 months and that renewals were common. The average prevailing rate of interest on short term loans was 6.4 percent, but varied between different sections of the state. In the western part of the state, the average rate was 7 percent, while in the north central region, it was 6 percent.

Effects of Land Value Inflation in Central Kentucky. Detailed records have been secured from 178 farmers who incurred large losses or lost their farms by the drop in farm

land value following the boom. The data obtained include figures showing the farmer's net worth before and after the boom and the total loss sustained; the work taken up for a livelihood by the farmers who lost their farms; how these farmers have fared in their new lines of work; the effect on the home and living comforts of the families of farmers who suffered loss as a result of the collapse of inflated values; the effect on the community activities of these men and their families; the effect on the education of their children and on the future vocations of the sons and daughters. In the instance of farmers who were able to refund their indebtedness and retain possession of their farms, the manner, terms and credit agencies involved were ascertained. Whether and to what extent the changed situation involved a change in the type of farming was also ascertained in each case.

Studies of Farm Tenancy. The trends in tenancy in 33 Bluegrass counties from 1880 to 1925 show an increase in the percentage of tenant farmers from 25.8 percent in 1880 to 39.7 percent in 1920, with a decrease to 37 per cent in 1925. The greatest increases in tenancy as well as the greatest occurrence of tenancy was in the six "inner" counties, the percentage rising in these from 24 percent in 1880 to 49.9 percent in 1920, and falling to 44.7 percent in 1925. In the eight "intermediate" counties in 1880, 24.4 percent of all farmers were tenants and in 1890, 23.6 percent. During the next 35 years, the percentage rose to 38.3 percent. In the nineteen outlying counties, the percentage was 26.9 percent in 1880, 25.3 percent in 1890, and increased each ten years to 37.6 percent in 1920. In 1925 there was a decline in tenancy to 34.2 percent.

Study of Farming in the Jackson Purchase. The farm organization phase of this study was practically completed during 1928, and two detailed reports prepared. The first of these shows returns obtained on the farms studied, an examination of weaknesses found in farm organization and practices and the cost of improvements, the production requirements, costs and returns for crops and livestock enterprises and the advantages and disadvantages of combining them. Important

problems in the Purchase Region were found to be the proper balancing of feed crops and livestock, and the determination of the proper combination of crops and livestock if cash crops are included.

Systems of Farming in the Purchase Region. A study of the most profitable combinations of enterprises on farms in the Purchase Region showed certain farms with systems returning good profits year after year, while returns from most of the farms were low. A careful analysis of the records included in the study showed that systems of farming that are proving most profitable and that are likely to continue most profitable generally have several of the following characteristics: Two or more important sources of income, including at least one cash crop for which the section has advantages as compared with other enterprises; one or more minor sources of income; the production on the farm of livestock products, truck crops and fruits, adapted to the section, that are needed in the household; a crop and livestock program that will maintain or improve the fertility of the soil; crop and livestock so balanced as to utilize the legumes, pasture and nonmarketable by-products to good advantage and provide good rations for the livestock; no more mature work stock than is needed to provide the necessary horse work; crops and livestock such that the man labor and horse work requirements are well distributed thruout the year; practices in growing crops and handling livestock such that yields and production approach recognized standards.

With the more profitable systems, adjustments have been made away from tobacco in response to the decreased demand and the resulting low prices for this crop. Generally, these adjustments have come about thru the gradual expansion of other enterprises. Usually the crops and livestock of the more profitable systems are well balanced in that they fit together and contribute to each other.

Study of Laurel County. From detailed data obtained from more than 200 farms and farm families in Laurel County, a study is being made by the Experiment Station and the

United States Department of Agriculture of the economic feasibility of using various types of land for crops, pasture and woodlots, as affected by elevation, topography, soil, present type of cover, cost of original clearing or brushing and "filth cutting," cost of fencing, relation to supplemental feeds, carrying capacity under different types of management, etc. An attempt is being made to determine the extent to which the production of crops and the utilization of land for meadow and pasture should be confined to the more level lands, or the extent to which the steeper slopes may be utilized. This problem is related to the question of size of farms, present and prospective, and this, in turn, to the question of trend of population in the region. The problem of utilization is being studied by using particular fields as units.

Farm Organization Studies. A group of 156 representative farmers in Taylor, Green and Adair counties showed a return of about $700 as an average for their year's work and management besides interest on the capital investment of $7514.00. Of the 156 farmers, the 25 having the highest net earnings and the 25 having the lowest net earnings were selected. The net earning of the 25 highest averaged $1580 as contrasted with $69, the net earnings of the 25 lowest, and $698 the average net earnings of all the farmers. Almost as striking is the contrast in the rate of return on the investment. The most successful 25 farmers earned a return of 18 percent on their capital investment as compared with 2.2 percent for the least successful farmers and 11 percent for the average of the entire group. An analysis of the figures of the most successful farms indicates as important factors the control of the cost of production as shown by the ratio of farm expenses to farm receipts; crop yields; proper feeding practices and high quality livestock; volume of sales.

An analysis was made of the business of 50 farms in Christian County. A similar analysis had been made on these farms for the business of the preceding year. The figures for the two years are being used as the basis of determining the most important profit factors in that territory. The most successful 12 farmers secured net earnings of $3883 per farm for

the labor and management of the operator as against a minus figure of $141 per farm for the labor and management of the least successful 12 men. The most important factors responsible for these differences appear to be better crop yields, better control of the cost of production, greater labor accomplishment per man and per $100 expended for labor, volume of sales per acre, better utilization of pasture and feed thru livestock, and a better utilization of the investment in farm machinery.

Tobacco. To determine to what extent yield and quality of tobacco are affected by various practices of topping and suckering, tests of the following methods of handling have been undertaken at the Experiment Station farm: (1) Plants topped as early as possible and suckers kept removed closely; (2) Plants topped early and two suckers allowed to grow, other suckers kept pulled closely; (3) Plants allowed to bloom out fully before topping, and suckers allowed to grow until tobacco is harvested; (4) Tobacco not topped until ready to harvest. In addition to yield and quality data, a time record of all operations connected with topping, suckering and cutting the tobacco is kept.

Tobacco Virus Diseases. Continuing previous studies on the sources of true tobacco mosaic infection, it has been shown that the infection may be spread at pulling time by men who smoke air-cured and fired-cured tobacco as well as by those who chew it. The hands become contaminated with the mosaic virus while handling dried tobacco carried in the pockets or while grinding it in the hands preparatory to filling the pipe and it may then be readily transmitted to healthy plants. By using sterile tobacco while pulling plants, and by pulling out the few mosaic plants found in a field of 15,000 plants about a month after setting, mosaic counts made in the second suckers showed only .7 percent mosaic, which may be considered nearly perfect control commercially. In former years, with no precautions, plants set in this field averaged about 8 percent infection following setting.

Further studies on mosaic in commercial tobaccos proved that each of 15 brands of smoking tobacco marketed in tins,

carried mosaic but that it was decidedly more difficult to contaminate the fingers with mosaic by handling these tobaccos than by handling cured natural leaf tobacco. Of 15 brands of cigars studied, about half were found to carry mosaic in a form readily transmitted to tobacco plants. A study of 11 brands of plug chewing tobacco was made by mixing sliced tobacco with water and rubbing the decoction on plants after pulling and before setting. Approximately 50 plants of each were set, and resulted in 7, 2, 1, 1, and 6 mosaic plants from 5 of the brands, respectively, the remainder being healthy. From the natural leaf tobacco decoction 41 of 64 plants set developed mosaic.

Three strains of the cucumber mosaic are being studied, two of which were previously reported as "puff" and "severe puff," the third being given the name of "mild puff" due to its effect on tobacco. Each of these produces mosaic in cucumbers and tobacco but with different degrees of intensity. The original culture of severe puff was found to be mixed with "healthy potato" virus. Each was obtained in pure culture, the former by transferring the mixture to seedling potatoes, which eliminated the cucumber mosaic, and the latter by transference to cucumbers which eliminated the "healthy potato" virus.

"Tomato streak" was produced by a mixture of the "healthy potato" virus with puff, severe puff, etch+, severe etch, and the various strains of true tobacco mosaic. It was also produced by a strain of tobacco mosaic designated C. T., when used alone. Dried tobacco containing this virus produces the disease if rubbed on healthy tomato plants, indicating that it is not a mixture of "healthy potato" virus and tobacco mosaic. A comparison of tomato streak produced by a mixture of the potato virus with a mild and with a severe strain of true tobacco mosaic proved that the latter produced a much more severe case of streak than the former. Evidence is accumulating which indicates that tomato mosaic of the type severe enough to be readily recognized is commonly caused by one of the etch group of viruses and not by true

tobacco mosaic, altho the latter group will cause tomato mosaic.

The eradication of solanaceous weeds within and from the near vicinity of two tobacco fields on the Experiment Station farm caused a marked reduction in virus diseases, other than true tobacco mosaic, as compared with fields in which the weeds were not eradicated. From the evidence that is being accumulated, the indications are that certain of the tobacco virus diseases have probably been introduced into solanaceous weeds from diseased potatoes and that such infected weeds not only constitute a menace to tobacco, but likewise to potatoes grown in the vicinity in subsequent years. Attempts to free a strain of Cobbler potatoes of the "healthy potato" virus, by sprouting the potatoes in absolute darkness and rooting the tips of the sprouts in the greenhouse failed, as it was found that the virus was present in the tips of etiolated sprouts 16 inches long.

Tobacco Leaf Spot Diseases. Studies on the control of angular leaf-spot and wildfire in the plant bed have suggested that wild plants, in the vicinity of the plant bed, may be at least partly responsible for the over-wintering of these diseases. An isolated burned plant bed, plowed out of bluegrass sod and sowed with seed raised in the greenhouse and presumably disease-free, developed angular leaf-spot in certain partially flooded areas following a heavy rain. All precautions had been taken to eliminate infection from a previous tobacco crop.

Further evidence was obtained the past season that much of the western Kentucky blackfire is due to abnormal nutrition of the plant rather than to bacteria, and that it may be largely controlled by the use of liberal applications of stable manure. Inoculation experiments with *B. angulatum* and *B. tabacum* conducted in the greenhouse on topped and suckered Turkish tobacco plants indicate that these organisms are much more injurious to nitrogen-starved plants than to those receiving liberal quantities of nitrogen.

Tobacco Black Root-Rot. Hybrid strains of burley highly resistant to black root-rot have been given a preliminary trial

by farmers this year in comparison with the previously introduced resistant selections. The hybrids have proved to be rapid growers and certain of them appear to be of excellent quality even when grown on infected land. Tests of three hybrid air-cured dark tobaccos resistant to black root-rot, in infected plant beds near Owensboro, in comparison with a susceptible variety, suggested that it may be possible to grow resistant plants in an infected bed with little fear of injury. Steamed beds, used year after year, in the vicinity of Owensboro, were found to be heavily infested with the black root organism and plants set from them were found to be starting slowly because of infection.

Tobacco Brown Root-Rot. This disease was particularly severe the past season in tobacco following corn. Isolations made from rotting rootlets from time to time thruout the summer, yielded a pythium-like organism, fairly consistently, when planted on non-acidulated potato agar and kept cool. Previous studies showed that corn roots, collected during the winter from the field, resulted in a disease of tobacco similar to brown root-rot when dead corn roots from a "continuous corn" plot were mixed with sand in which the tobacco was subsequently grown. The rotting tobacco rootlets were found to contain pythium spores of the same type as those found in rotting corn roots. The observation was made that tobacco following corn was much more severely injured by brown root-rot than tobacco following red clover, in two adjacent rotations in which tobacco, wheat, clover and corn were grown. The inference is that the pythium responsible for corn root-rot in Kentucky, is likewise the cause of brown root-rot of tobacco.

Relation of Chemical Character to Quality of Leaf Tobacco. The best grades of burley tobacco contained 30 percent more chlorine than the poor grades of this variety. The best grades of dark tobacco contained 20 percent more chlorine than the poor grades of this variety. The averages for all good grades of burley and dark tobaccos show 29 percent more chlorine than the poor grades of these varieties. The average chlorine content in all grades of dark tobacco was

209 percent more than in the corresponding grades of burley tobacco. The sulfate content in different grades of dark tobacco appears to be about 10 percent larger than in the corresponding grades of burley tobacco.

Effect on Conservation of Nitrate by Early Fall Seeding on Tobacco Land. Barley and wheat, respectively, were seeded at different times in the fall on small plots on which tobacco had been grown during the summer. The nitrate content of the soil was determined from time to time to ascertain the extent to which the larger growth of the earlier seedings had taken up the nitrate and correspondingly reduced the amount which probably would be largely lost in the drainage waters over winter. The effectiveness of the early seeding of barley in removing the nitrate from the soil was very apparent. The greater effectiveness of barley over wheat in this respect was also apparent. The fact that there was almost the same amount of nitrate nitrogen under wheat of October 10 and November 7 seedings indicated that wheat seeded October 10 had not made sufficient growth to use any appreciable amount of nitrate and suggests that wheat seeded at or after the usual time may not effectively use up soil nitrate and prevent loss in the drainage waters thru the winter.

Relation between Chlorine in Fertilizer and Chlorine Content of Burley Tobacco. Analyses were made during the year of the chlorine in tobacco grown during 1927 on plots fertilized, respectively, with commercial potassium chloride and potassium sulfate at rates varying from 50 to 800 pounds per acre. The chlorine content of the potassium chloride fertilized tobacco was almost in direct proportion to the amount of chlorine applied in the fertilizer, up to and including the 400-pound application. There was a further increase with the 800-pound treatment, but at a much reduced rate. The percentage of chlorine in the oven-dry tobacco increased from .048 in the unfertilized tobacco to 5.555 in the tobacco fertilized with 400 pounds of potassium chloride, and to 6.511 in the tobacco fertilized with 800 pounds of potassium chloride. Applications of potassium sulfate had little effect on the chlorine content of the tobacco. The percentage of sulfur in the

tobacco increased with increasing applications of potassium sulfate, but at a much lower rate than in the case of chlorine, the range being from .4 percent in the unfertilized tobacco to 1.187 percent in the tobacco fertilized with 800 pounds per acre of potassium sulfate.

Infectious Abortion. Close observation was made of two herds of cows under treatment for infectious abortion. One-half the number of cows in each of these herds received the bacterin treatment, the remaining half received no treatment at all. Infectious abortion was prevalent in these herds before the observation was begun. In one herd, numbering 100 head, there were two abortions each among the vaccinated and unvaccinated cows. In the second herd, no abortions occurred among either the vaccinated or unvaccinated cows.

In the routine testing of cows for infectious abortion, several herds were tested for *B. melitensis* infection and the blood of a few cows responded positively to this test. Seven samples of blood from persons affected with a fever reacted positively to *B. melitensis* infection. Three samples of human blood responded positively to *B. abortus* infection. The milk from seven cows was tested for the abortion and melitensis organisms with negative results.

One hundred and forty herds numbering 1977 cows were tested for infectious abortion. Bacterin sufficient for 1242 cows in 62 herds was sent to veterinarians of the state for use in vaccination.

The bacterin treatment for infectious abortion was administered to 2681 mares on 88 farms. The bacterin was made from the *Bacillus abortivo-equinus* organism, and so far as determination can be made, not a single abortion occurred among these mares due to this organism.

Thirty-seven fetuses from mares were cultured. A streptococcus was isolated from 8;*B. abortivo-equinus* from 8; the others were found to be negative to either of these organisms. The dams of the fetuses from which the organism *B. abortivo-equinus* was isolated had not been vaccinated against this organism.

A number of fetuses from aborting sows were cultured during the year and *B. abortus suis* isolated from the internal organs from pigs of four of these sows. Treatment with a bacterin made from *B. abortus suis* was given to 151 sows.

Infection of Fetuses and Foals. Bacteriological examination of 147 fetuses from mares showed that 69, or 47 percent, were negative and 78, or 53 percent, positive. Of the fetuses positive to infection, 57 showed streptococcus, 10 *B. abortivo-equinus,* 2 *B. viscosum equi,* and 9 miscellaneous.

A total of 164 foals have been examined postmortem and bacteriologically. The foals varied in age from those dead at birth to not exceeding nine months of age, the greater number ranging from one to ninety days. Of these foals, 41, or 25 percent, were negative, and 123 or 75 percent were positive on culture to bacterial infection. In the case of ten of the foals, death was unmistakably due to traumatic injury. Of the infected foals streptococci were insolated from 33, *B. viscosum equi* from 63, *B. abortivo-equinus* from 8, and 19, showed miscellaneous types of infection.

Taking the fetuses and foals together, it is plainly evident that disease due to infection is the most important factor to be dealt with. Abortions due to *B. abortivo-equinus* are to be prevented by vaccination of the mare. Abortions due to other forms of infection are largely to be prevented by mating only mares and stallions whose genital tracts are free from infection and thru the observance of strict sanitary precautions at the time of service. This also applies to the prevention of loss of many foals from infection, as a large percentage of cases of infection in young foals are of prenatal origin. In the case of some of the older foals, it is a matter of care and management after the birth of the foal.

Sterility in Mares. From a summary of examinations of 2350 barren mares, it was found that 1528, or 65 percent, were apparently free from infection of the genital tract and, therefore, that their failure to breed was due to causes other than infection. Of the 822, or 35 percent, found to be suffering with infection of the genital tract, cervicitis and metritis were apparently the causes of their failure to reproduce. All the

mares received a thoro clinical examination supplemented by a bacteriological examination of the cervix and uterus. The mares negative on bacteriological examination were on the whole clinically normal, while those positive on bacteriological examination showed slight or marked clinical evidence of inflammation.

Of the 822 mares showing evidence of infection, 540, or 66 percent, were infected with streptococcus genitalium; 94, or 11 percent, with encapsulatus genitalium, and 182, or 23 percent, were classed as miscellaneous types of infection. Possibly a considerable number in the miscellaneous group could ultimately be otherwise classified if further and repeated examinations had been made.

Acidosis of Pregnant Ewes. The average calcium, potassium and phosphorus content in 100 cc. of blood serum of 10 normal pregnant ewes was found to be as follows: calcium 9.7 mg.; potassium, 27.4 mg.; phosphorus, 7.0 mg. In the blood serum of 7 normal pregnant ewes at term, the averages were calcium, 9.1 mg.; potassium, 22.5 mg.; and phosphorus, 5.1 mg., whereas in the blood serum of 13 pregnant ewes suffering with acidosis, the averages for these elements were calcium, 6.6 mg.; potassium 44.1 mg., and phosphorus 5.7 mg. For further work on this subject, two lots of 5 ewes each were fed the following rations: Lot 1 received 3 pounds per sheep, once each day, of a mixture of 150 pounds of corn, 150 pounds of bran and 50 pounds of linseed oil meal, with alfalfa hay in addition. Lot No. 2 received 1 pound per sheep, once each day, of a mixture of 100 pounds of corn and 100 pounds of oats, with corn stover and poor timothy hay in addition. Analyses of the blood serum from the two lots of sheep were made monthly and it was found that after a period of five months, the averages for the elements calcium, potassium and phosphorus, were as follows: Lot 1, per 100 cc. of blood serum, calcium 10.2 mg.; potassium, 23.3 mg.; and phosphorus, 5.7 mg.: Lot 2, Calcium, 7.5 mg.; potassium 28.0 mg.; and phosphorus, 6.8 mg., and showing a lowering of the calcium content of the blood serum and

an increase in the potassium and phosphorus content of the serum of the sheep fed the inferior diet.

Hog Feeding. A test was conducted during the late fall and early winter to determine the rate of gain and cost of gain of hogs fed ear corn in the mud as compared with hogs fed ear corn on a platform and hogs fed ear corn from a self feeder mounted on a platform. The test was begun October 23 and closed December 11, a period of 49 days. Lot 1, the hogs receiving ear corn fed on a platform made an average daily gain of 1.67 pounds per head and required 5.27 pounds of ear corn per pound gain. Lot 2, fed ear corn from a self-feeder mounted on a platform made an average daily gain of 1.65 pounds per head and required 5.70 pounds of ear corn per pound gain. Lot 3, fed ear corn in the mud, made an average daily gain of 1.55 pounds and required 6.26 pounds of ear corn per pound gain.

Steer Feeding. A second test was conducted, from December 16 to August 11, a period of 239 days, to compare the daily rate of gain and economy of gains between steers fed corn during the winter and finished the following summer on grass without corn, and steers carried thru the winter on the same feeds, with the exception of corn, and finished the following summer on grass with corn. The final average weight of the lot receiving corn in winter was 1308 pounds—average gain per steer of 364 pounds. The final average weight of the steers receiving corn on grass was 1350 pounds—average gain per steer of 394 pounds. The net returns over the feed consumed and shipping expenses were $53.48 per steer for the cattle that received corn during the winter, and $58.48 per steer for the cattle that received corn on grass. The initial cost of the cattle was $9 per hundredweight. Both lots of cattle sold on the Cincinnati market, August 13, for $14.50 a hundredweight. There was very little difference in the dressing percentage of these two lots of steers, but the lot receiving corn during the winter period showed to a slight advantage in this respect. There was practically no difference in the quality of the carcasses of these two lots.

Manganese, Copper, Zinc, Boron, Necessary Factors in Production of Plants and Animals. Recent experiments show that manganese, copper, zinc and boron are necessary factors in the production of important agricultural crops. The experiments show that manganese is a necessary factor in the synthesis of chlorophyll and carbon assimilation.

Copper increased the growth of plants and the production of their seeds. Zinc and boron produced larger and heavier stalks and stems of plants but did not produce a corresponding increase in the yield of seeds. However, it is possible that lower concentrations of these elements than those used might be favorable to seed production as well as to stalk and straw production. Quantitative data have been obtained in regard to the occurrence and possible function of manganese, copper, zinc and boron in the metabolism of animals. It has been shown that manganese, copper, zinc and boron occur in greater concentrations in such important organs as the liver, brain, pancreas, heart, lungs and spleen than in the muscular tissues of animals. Data also show that these elements occur in still greater concentrations in the embryos of mammals than they do in the larger and more mature animals. It may be inferred that these elements have important functions during the development of the embryo and in the early stages of growth, and in the case of mammals it is highly important that the mother be supplied with food rich in these elements during the periods of pregnancy and lactation.

Recent experiments with white rats show that inorganic copper compounds in connection with iron compounds, perform an important function in the reduction of hemoglobin in animals having red blood. Heretofore it has been assumed that iron alone was concerned in the production of hemoglobin. It has also been demonstrated that those tissues and organs of plants and animals which have the greatest vitamin potency contain larger amounts of copper, manganese, zinc and boron, thus suggesting an interrelationship existing between vitamins and the occurrence of the less common elements in plants and animals.

Since all food material and vitamins are ultimately synthesized in the plant's economy, it is therefore a matter of fundamental importance to know what elements are necessary for the normal growth and metabolism of plants and animals in order to better understand how to produce foods and animals not only in large quantities but of the highest quality as well.

Vitamin Content of Kale and Mustard Greens. An investigation of the A, B, C, D vitamin content of kale and mustard greens, fresh, cooked and canned has been in process for some time. In the vitamin A tests, kale, fresh, cooked and canned, fed ad libitum to first generation rats was found to be uniformly both a preventive and curative of ophthalmia. Fresh or cooked kale fed as 20-percent of total food intake (average food intake 10 grams daily) prevented ophthalmia in first generation rats and produced an average gain during the 8-weeks' test period (after weight decline) of 72 grams for the males and 55 grams for the females. Ophthalmia was not prevented in second generation rats on 20-percent fresh, cooked or canned kale. During the 8-weeks' test period, fresh kale showed an average gain of 25 grams for second generation rats; cooked kale 15 grams, canned kale negative.

In view of the relation that seems to exist between vitamin A and reproduction, the potency of kale and mustard greens in this respect was tested with rats receiving two grams of supplement daily (Sherman and Munsell diets). Four females from each series were mated with males from the same series. Without exception they produced normal litters. Females from each of these litters were in turn mated with males from the same series and they without exception produced normal litters.

The vitamin D content of fresh, cooked and canned kale and fresh and cooked mustard greens was investigated, using as experimental animals albino rats of known ancestry and nutritional history. Altho there was not complete correlation between the different methods of judging, the evidence seems sufficient to justify the conclusion that in none of the cases was rickets prevented.

In investigating the vitamin C content of fresh, canned and cooked kale and of fresh mustard greens, an effort was made to determine the minimum amount of greens that would prevent scurvy. The results of the test indicate that in order to prevent scurvy in the experimental animals used, it required 0.75 gram of fresh kale, 3 grams of cooked kale, and that 1 gram of fresh mustard greens prevents scurvy, but 0.5 gram does not.

The content of vitamin B as a whole was investigated first and later tests were made to determine, if possible, the relative amounts of the anti-neuritic and anti-pellagric factors to be found in kale and in mustard greens. Preliminary work showed that fresh, cooked and canned kale fed ad libitum prevented beri-beri and promoted growth.

Metabolism in the Chicken. In a study of the calcium requirement of the growing chick, five lots of White Leghorn chicks were fed a basal ration consisting of a mash of ground yellow corn 80 parts, wheat middlings 20, tested cod liver oil 2, sodium chloride 1 part, and skim-milk ad libitum. In each lot, this basal mash was supplemented by a mineral mixture consisting of pure calcium carbonate and tricalcium phosphate varying in ratio from 0:0 to 5:5 parts. The lots receiving the two compounds in the ratio of 2:2 and above, grew at the same rate, while those receiving the smaller quantities showed retarded development. Analyses show that the percentages of ash in the dry leg bones of the chick during their progressive development were largest in those lots receiving the compounds in amounts equal to 2:2 and above, than those receiving the smaller amounts; and further that the percentages of calcium in the dry leg bones remained approximately constant in all lots thru the experiment.

The results of an investigation to determine to what extent the growing chick can utilize the calcium in pure calcium carbonate, calcium sulfate, and tricalcium phosphate, the effects of these compounds on the growth of the chick and their in-

fluence on the development of the bones, indicate that tricalcium phosphate, alone or with calcium sulfate or calcium carbonate, caused increased growth and leg bone development of the chick, even tho it did not materially influence the percentages of ash in the bones or the percentages of calcium and phosphorus in the ash; that calcium carbonate and calcium sulfate serve equally well as sources of calcium for the growing chick, and tricalcium phosphate equally well as a source of calcium and in addition supplies required phosphorus; that a yellow corn-wheat-middlings-skim-milk ration contains enough phosphorous to supplement that in the absorbed egg yolk for the growth of White Leghorn chicks for the first three weeks.

Results have been obtained concerning the influence of certain mineral materials, such as high-grade limestone, raw bone meal, ground rock phosphate and a material very rich in dicalcium phosphate, on the growth of the White Leghorn chick when fed as a supplement to a mash consisting of ground yellow corn, wheat middlings, dried skim-milk, tested cod liver oil and sodium chloride. All mineral supplements supplied the same quantity of calcium. The growth and bone development of the chicks when fed this ration without mineral supplement were greater than when the calcium was supplied as a calcium carbonate in the quantities used in the experiment. The growth of the lot receiving no mineral supplement approximated that of the lot receiving the dicalcium phosphate, while those lots receiving bone meal, bone meal and limestone, and rock phosphate showed the greatest growth and bone development.

In studying the transference of calcium from the food in the intestines by means of the blood stream to the oviduct, where it is deposited as egg shell, laying hens were anesthetized with chloral hydrate and an incision made in the lower left portion of the abdomen. The intestines were carefully raised and samples of blood obtained from the large artery supplying blood to the intestines and from the large vein carrying the blood from the intestines. In a hen in the laying con-

dition, this arterial blood showed 17.6 milligrams and this venous blood 18.8 milligrams of calcium in each 100 cubic centimeters of blood serum. In another hen in active state of laying, the corresponding arterial blood contained 23.2 mg. and the venous blood 25.4 mg. per 100 cc. of blood serum. In a hen in a non-laying condition, the arterial blood supplying the intestine contained 17.75 mg. and the returning venous blood 17.83 mg. of calcium per 100 cc. of blood serum. From the studies of the three hens, it is suggested that calcium is taken into the blood stream directly from the materials in the intestines, and that the calcium in the blood stream varies between narrow limits in individual hens.

A study of the hydrogen ion concentration of the sexual organs and some of their secretions of the White Leghorn chicken shows that the reaction of the semen of a mature white Leghorn cock is highly alkaline, being pH 7.3. This is approximately the same as that of the stallion and a little lower than that of man. The hydrogen ion concentration of the oviduct of the laying hen shows an acid reaction. The "bloom-secreting" part of the oviduct of a laying hen has a pH value varying between 5.8 and 5.9, the egg shell membrane secreting part between 5.6 and 5.9; the "albumin-secreting" part between 6.3 and 6.6., and the funnel, 6.3 to 6.4. Egg albumin immediately removed from the mucosa showed a pH of 6.7 or 6.8. The alkalinity of egg albumin increases with time until a pH value of 8.8 is reached in a three weeks old egg. In a non-laying hen, the pH value of the mucosa of the funnel and albumin-secreting part are the same as in the laying hen, but the parts secreting the egg-shell membranes, the shell and the bloom are distinctly more acid in a laying hen than in a non-laying hen. This suggests the possibility that this change in acidity is connected with the development of the shell and its membranes. It is interesting to note that the spermatazoa existing normally in an alkaline secretion must travel the dis-

tance of the oviduct, which is acid in reaction, before they fertilize the ova.

Effect of Vitamin D Supplements on Egg Shell Thickness. Six pens of 30 birds each, each pen containing 15 Leghorns and 15 Barred Rocks, were involved. The ration fed was the same in all the pens, except that pen 13 received its corn as shelled corn in the litter, whereas in the other 5 pens the corn was ground and fed with the mash. The birds were fed a ration containing a sufficient amount of vitamins A, B, C and E, but deficient in vitamin D. Eggs from each pen were tested at stated intervals thruout the experiment for thickness of shell. The data obtained justify the following conclusions: (1) Thin or soft shelled eggs were produced on rations of insufficient amounts of vitamin D. (2) There was no significant difference between the thickness of shell of eggs of different shapes and sizes. (3) Certain hens possess an inherited inability to produce eggs with heavy shells even under normal conditions.

Supplements for the Poultry Laying Mash. The third year of the test to determine the percent of meat scrap needed in the mash to properly supplement a grain-skimmilk ration was completed and the test concluded. The work for the first two years was conducted with Barred Plymouth Rock pullets and the third year with both Barred Plymouth Rocks and White Leghorns in each pen. Among the conclusions that may be drawn from the tests are that (1) pullets receiving all the sour skimmilk they can drink may profitably be fed a dry mash containing not to exceed 5 percent of meat scrap; (2) a dry mash containing 2½ percent of meat scrap gives very satisfactory results in supplementing a grain-skimmilk ration.

All-Mash for Laying Hens. Four pens of 100 pullets each, two pens of White Leghorns and two Barred Plymouth Rocks, were used in a comparison of all-mash with grain and mash. The rations fed to all four pens were identical except that the all-mash pens received all feed in the ground form as dry mash. The mash and grain pens received shelled corn morning and evening in the litter of an amount equal to the proportion which was ground and added to the mash of the all-mash pens.

The average egg production for the four winter months and for the year is given in the following table:

Ration	Winter	Year
Barred Rocks		
Pen A—All Mash	54.6	187.4
Pen B—Mash and Grain	54.7	174.3
White Leghorns		
Pen C—All Mash	59.4	182.7
Pen D—Mash and Grain	55.4	182.0

Proper sanitation was more difficult in the all-mash pens because of moist droppings and wet litter. There was no significant difference in the mortality, health and hatchability of the various pens. A distinct relationship between maintenance of body weight and egg production was observed, a drop in body weight being followed by a slump in egg production.

Rate of Feathering. Observations have been made during the past three years on the rate of feathering in Barred Rock chicks. A study of the accumulated data indicates that the rate of development of feathers over the back is closely related to rate of growth, the heavier chicks feathering more rapidly. Female chicks which feathered slowly over the back were found to be poor winter layers, whereas high producing hens feather rapidly as chicks during the first three months. Chicks from an exhibition strain were compared with those from the production strain bred at the Experiment Station and the following observations noted: (1) The exhibition chicks grew at a slower rate than the production-bred chicks. (2) Slow feathering chicks were more common in the exhibition stock than in the production stock. (3) A relation was found to exist between quality of barring and slow rate of feathering, the barred feathers of the best quality growing more slowly.

Bacillary White Diarrhea. In a study of the agglutination test for the detection of bacillary white diarrhea, a flock of 100 hens are being tested at thirty day intervals, until twelve tests have been completed. All hens were definite positives when placed on test, and the majority of them have given consistent, clear-cut, positive tests each month. Marked

variations in the titer of the sera of several hens have been observed, altho none has ever given a negative reaction. Post-mortem examination was made of all positive birds in this flock that died or that were killed at the completion of twelve monthly tests. All showed visible lesions of bacillary white diarrhea infection and *Salmonella pullora* was isolated from every case. The mortality among this flock of hens, to date, has been 30 percent. Egg production has been on the whole very low, some of the hens not laying an egg during the twelve months that they have been on test. Sera from twenty-five birds, all reactors, were sent to eight laboratories where they were tested for bacillary white diarrhea. The agreement in these comparative tests was 96.1 percent, which is much higher than that reported by other laboratories conducting similar check tests.

Lameness in Poultry. During the past year, Kentucky poultrymen have experienced considerable trouble with lameness in pullets and cockerels. A study of the condition seemed to indicate that the trouble might be due to several causes and that the lameness or paralysis under observation was only a symptom and not a specific condition. Post-mortem examination was made of 60 cases of lameness or paralysis originating from one flock. No evidence was obtained from the examination to lead to definite conclusion as to the cause.

Peaches. A block of 3-year-old Elberta peach trees comprising .69 acre, on the Station farm, yielded 112.8 bushels of fruit. This block of trees suffered heavy defoliation as a result of the excessive rains during May and June. However, within three weeks after rains ceased, the dropping of leaves had practically ceased. That excess soil water was the direct cause of defoliation is further substantiated by the fact that trees located on well-drained land suffered little or no defoliation.

This block of Elbertas was set with three grades of trees: Small 2 to 3 feet, caliber 5/8-7/8 inches; medium, 3 to 4½ feet, caliber 7/8-9/8 inches; large (oversize) 4½ to 6 feet, caliber 9/8 inches and up. The small and medium sized trees have

made as good growth as the larger trees. They were easier to train and seem to be superior in form. No differences occurred in fruit production this year. The orchard was divided into three groups for pruning: one winter pruned, one summer pruned, and one pruned both summer and winter. The time of pruning shows no practical effect on tree size or fruit production.

In a thinning experiment, to determine the value of using individual branches to show the comparative results on time of thinning, the results seem to indicate that for early varieties thinning should not be done much later than 42 days after bloom to secure the greatest advantage from the practice. Thinnings 57 and 74 days after bloom showed a marked falling off in increased size over checks as the season advanced. The varieties used were Carman, June Elberta and Hiley, in a fourteen-year-old orchard.

Berries. A small dewberry planting was made in the spring of 1928. A good stand was secured and they made good growth. These will be utilized to study methods of trellising and management.

The new planting of raspberries, with the exception of the Kansas variety, made a good start. One of the chief purposes of the planting was the determination of varieties highly resistant to the anthracnose disease, since this disease seems to be the principal limiting factor in raspberry growing in Kentucky.

Of the black raspberries, the Quillen showed a very high degree of resistance in comparison with all others tested. It seems to be similar in other characteristics to the Cumberland which has long been the standard in this part of the country. Of the red varieties, the Latham and the June were noteworthy.

Pear and Apple Blight. Tests for the control of pear and apple blight have been conducted for the past three years in Johnson County in an orchard in which the disease had caused nearly complete loss the previous five years, in a block of Yellow Transparent apples and in two blocks of Kieffer and

Garber pears. Practically complete control of blight has been obtained in the Yellow Transparents and in an adjacent block of pears thruout the 3-year period by cutting out a few cankers in the pears. No cankers have been found on the apple trees. A satisfactory set has not been obtained in the other pear block and blossom blight has caused some damage each year. It is believed that a lack of vigor in the trees accounts for the poor set and results in the bloom remaining open for a longer period, giving the blight an opportunity to spread.

Leafhopper Injury. A study of the leafhopper, *Empoasca fabae* showed that this insect is responsible for a great deal of injury to clovers and alfalfa. Injured leaves of clovers lost their natural color and became yellowed or browned, or took on a pinkish, purplish, reddish or bronzy cast. The injured leaves of alfalfa became yellowed. Infested clovers and alfalfa made much less growth than uninfested plants and many of the plants died from the effects of feeding of the leafhoppers. A single adult or nymph was able to kill a young plant. The foreign clovers were much more severely injured than the native strains of red clover. The failure of clovers during midseason or a little later can be attributed to some extent to the injurious effects of the feeding of the leafhopper, *Empoasca fabae*. Such feeding causes the clovers and alfalfa to go into the winter season in a weakened condition and with reduced root-systems and it is believed that the plants are more subject to winter injury for this reason.

Rotative Cropping. Two plots on the Lexington soil experiment field were devoted to continuous corn culture for thirteen years in comparison with corn in a rotation of corn, soybeans, wheat and clover, and also in a rotation of corn, wheat and clover. The average yield on continuous culture for thirteen years was 29.4 bushels; in the 4-year rotation, 53.4 bushels; and in the 3-year rotation 54.8 bushels. At the end of the thirteenth year, the continuous corn plot was changed to corn-wheat-clover rotation. The yield of the first clover crop was 4500 pounds, while in the 4-year rotation it was 3960 pounds and in the 3-year rotation, it was 4275 pounds. The

yields of corn following these clover crops were; in the former continuous corn culture, 63.8 bushels; 60 bushels in the 4-year rotation, and 76 bushels in the 3-year rotation.

After nine years of cropping in various rotations without the return of manure or fertilizers and with all crops harvested, the following yields of corn were obtained this year in the different rotations:

	Bushels per acre
Corn-wheat clover	90
Corn-wheat-orchard grass	75
Corn-wheat-soybeans	66
Corn-soybeans-wheat	53

In the soybean rotations, a winter cover crop is used preceding the corn.

Seeding Legumes on Established Bluegrass Sod. Seedings of sweet clover, white clover and common lespedeza, respectively, were made on plots in a field of bluegrass, near Lexington, which had been seeded in the fall of 1920. The stand of bluegrass was good, but the growth not vigorous enough for good pasturage. Satisfactory stands and fair growth of lespedeza were secured, but contrary to what probably would usually be expected, the plants did not mature enough seed to give satisfactory reseeding. The stand secured and the growth made with each of the three legumes was better on pastured than on unpastured areas. The results are not extensive enough to determine, in general, whether satisfactory stands and growth of white or sweet clover can be secured by seeding in old bluegrass pastures in Kentucky which are lacking in vigor but have a fair stand of bluegrass. However, they do indicate that considerable difficulty is to be expected in such attempts and suggest that lespedeza is a much safer legume than the other two for such use.

Lespedeza. Lespedeza was sown with several different grasses in 1927 to study its effect upon the vigor and stand of the grasses. In the Bluegrass region there has been some

hesitancy in sowing lespedeza in pastures, as it was feared that it might interfere with the growth of bluegrass. Lespedeza was sown at the rate of 25 pounds per acre—much heavier than it would often be sown in pasture mixtures—in order to make the test severe. The variety used was the Korean, which reseeds itself heavily in this latitude and which has an earlier, more vigorous growth than the common lespedeza. During 1927 the heavy growth of lespedeza practically suppressed the grass, but in 1928 the bluegrass thickened to such an extent as to give a practically solid stand, and the lespedeza made an inferior growth. Redtop has also largely suppressed the lespedeza. In the orchard grass-lespedeza plots, the latter remained thick but did not injure the orchard grass stand.

Red Clover Breeding. The selfing studies were continued during the past summer, being confined to the material secured by crossing self-fertile lines on superior heterozygous plants. Much of this material was of the third generation. The work of the past summer shows that the segregation of self-fertile plants has resulted in a proportion such that about one-third of the material is sufficiently self-fertile to make it worthy of use in breeding work.

Mass selection for mildew resistance continues to make promising progress.

Tests of Red Clover from Different Sources. A continuation of the experimental work upon red clover seed of various origins, in cooperation with the United States Department of Agriculture, has again demonstrated the decided inferiority of foreign seed. None of the foreign lots in the test of 1926-27 produced a hay crop in 1927, all but the Russian and Canadian having been completely killed by the severe winter weather. These gradually disappeared during the following spring. The northern-grown domestic lots likewise suffered practically complete losses during the winter. The only lots in the test to survive the winter were those produced in the general latitude of Kentucky; the best, a Kentucky strain, yielded 2.1 tons of hay (12% moisture). Not all lots produced in this region are of value, however, as one such was likewise a complete failure.

The test of 1928-29 has, for the first time, revealed marked differences in fall stands. All foreign and northern domestic lots have suffered almost or altogether complete reduction of stand during the summer. The cause in the case of the domestic lots has been for the most part, if not entirely, an attack of the southern anthracnose (*Colletotrichum trifolli* B. & E.). Many of the Tennessee and Kentucky lots are apparently highly resistant to the disease and, consequently, have suffered but slightly. Some, however, are no more resistant than lots of northern origin. The cause of the loss of the European lots was not clearly apparent. There are at least a few strains now being produced in Kentucky which are extremely well adapted to the State.

Wheat. Only a very small percentage of the wheat crop of Kentucky survived the winter of 1927-28, and in the central part of the State destruction was almost complete. The relative winter resistance of the different varieties and strains being tested at the Station was shown in a very striking manner. In some cases scarcely a plant survived, while a few varieties and strains came through with a very good stand. One strain, secured a number of years ago from western Kentucky, under the name of Kentucky Blue Stem, proved especially hardy. In previous tests it has given satisfactory yields of good quality grain. A strain of Michigan Amber and a pure line selection from Currell's also proved quite hardy.

Effect of Fertilizers and Lime on Germination of Certain Seeds. No injury to germination or early growth of corn was caused by 4-10-6 fertilizers used in varying amounts from 125 to 500 pounds per acre and distributed in a volume of soil 3x10 inches to the depth of 1.5, 3 and 6 inches, in the case of the lighter applications, and 6x10 inches to the same depths in the larger applications. The corn was planted in the center of the volume of soil in which the fertilizer was used. The nitrogen was one-half nitrate of soda, one-fourth sulfate of ammonia and one-fourth tankage.

In a test in the spring of the year, hydrated lime drilled with oat seed, thru the fertilizer attachment of a grain drill,

at the rate of 450 pounds per acre, caused no injury to germination or early growth of oats.

Hydrated lime, acid phosphate, and mixture of hydrated lime and acid phosphate in the ratio of 2:1 were drilled, in the fall of the year, in contact with wheat, thru the fertilizer attachment of a grain drill, without any injury to germination or fall growth. The respective amounts used per acre were 600 pounds of 16 percent superphosphate, 640 pounds of hydrated lime and superphosphate mixed in the ratio of 2:1, and 580 pounds of hydrated lime. These were maximum deliveries of the drill, which had disks 7 inches apart.

In a test in which calcium oxide was placed by hand over wheat seed in a furrow and mixed with the soil and seed by dragging a pointed stick in the furrow, no injury was done to germination until 1500 pounds per acre was used. This amount reduced germination about 10 percent, and 200 pounds per acre reduced it about 20 percent.

Soil Experiment Fields. Due to weather conditions, the year has been one in which good soil management has shown up unusually well. The winter vas very severe on wheat. The crop failed on the Campbellsville field, but came thru the winter in fair shape at Mayfield, Greenville and Hopkinsville. Wheat is not grown on the other experiment fields, except Lone Oak, where it was not grown this year owing to a change in plans of the field. The following yields of wheat were obtained:

	No Limestone or Fertilizer Bus. per acre	Limestone Superphosphate Bus. per acre
Greenville	4.5	20.0
Mayfield	4.2	21.8
Hopkinsville	6.6	14.3

On each field, wheat was grown in two different rotations, in one of which wheat followed tobacco.

A clover crop grown in regular rotation was harvested on six of the fields. The following yields of field-cured hay again

show the importance of lime and phosphate fertilizers in soil management.

	No Limestone or Fertilizer Lbs. per acre	Limestone Superphosphate Lbs. per acre
Berea	1035	4200
Fariston	410	3030
Greenville (Lespedeza)	850	1960
Campbellsville	1278	3607
Hopkinsville	1900	4450
Mayfield	1662	4217

The check plots were largely grass, while on the treated plots clover predominated.

Soybeans were grown in rotation on four fields with the following yields:

	No Limestone or Fertilizer Lbs. per acre	Limestone Superphosphate Lbs. per acre
Berea	6075	6830
Fariston	1515	6980
Greenville	2565	3760
Mayfield	3663	4515

These are field-cured weights and would further lose about 30 percent on complete air-curing as shown by tests.

The yields of corn in rotation on the seven fields were as follows:

	No Limestone or Fertilizer Bus. per acre	Limestone Superphosphate Bus. per acre
Berea	9.4	29.9
Fariston	3.2	47.3
Campbellsville	40.8	70.8
Greenville	27.1	59.6
Hopkinsville	23.7	35.2
Mayfield	24.7	41.8

The corn on the various fields was manured on the fertilized and unfertilized soil alike with an amount equal to the weight of the crops removed from the check plots in the preceding year, except at Fariston where one-half of each plot was manured for the first time in thirteen years at the rate of six tons per acre, and Campbellsville where each plot was manured at the rate of six tons per acre for the first time in ten years.

The following yields of tobacco were obtained:

	No Fertilizer Lbs. per acre	Complete Fertilizer Lbs. per acre
Campbellsville	755	1270
Greenville	620	1080
Mayfield	608	928

The fertilized soil at Greenville and Mayfield was limed several years ago.

Raw ground phosphate rock has been used on all these fields in double the amount of superphosphate used. When used on unlimed soil, it has generally been equal to or better than superphosphate; but in the limed soil, superphosphate has been better, except at Berea and Mayfield where they have been about equal.

In a comparison of basic slag phosphate and superphosphate at Campbellsville, the two forms have been about equally effective.

The Lone Oak experiment field was changed this year from a system of plot treatments into rotation and pasture demonstrations. The results were duplicating those at Mayfield, and it was thought best to use the Lone Oak field for other purposes. Two rotations are being used. One is corn and wheat, with sweet clover seeded in the wheat and turned under the next spring for corn. The other rotation consists of corn, wheat and alfalfa for two years. Part of the field is used for a demonstration of pasture mixtures on terraced land. Part of the 4-year rotation is left untreated, while the

remainder has a standard treatment of limestone and superphosphate.

Prior to converting the field to this purpose, it was badly infested with wild onions, as it had been from the beginning of the work. Some three or four years were spent in eradicating the onions by different culture methods and cropping systems. At present no onions can be found. The most effective method was that of the United States Department of Agriculture outlined in Farmers' Bulletin No. 610. This method consists in plowing in late fall and the use of clean cultivated cropping the next spring and the repetition of the process for two years. If faithfully followed, the method is very effective. Land that is subject to washing should be terraced before beginning the process of eradication.

Methods of Analysis. The use of sulfuric acid and a chlorate for quickly oxidizing plant tissue has been found very advantageous in certain kinds of analyses, and a method for determining nitrate, based on this procedure, has been worked out. The new method should be important to workers in plant physiology, because it is rapid, simple, inexpensive and applicable to small quantities of material.

A satisfactory method for preparing a colorless solution of green plant tissue by the use of calcium hydroxide and copper sulfate preliminary to the determination of nitrate by the phenoldisulfonic acid method has been worked out.

The quinhydrone electrode has come into rather extensive use, during the past several years, for the determination of the hydrogen-ion concentration of soils. In point of simplicity and speed, it is much superior to the hydrogen electrode. Comparative determinations, however, with the two electrodes on a considerable number of soil samples from various parts of Kentucky gave poor agreement and indicated that the quinhydrone electrode can not be satisfactorily used with Kentucky soils. The quinhydrone electrode reads in general from .5 pH to over 1.0 pH higher than the hydrogen electrode, depending upon the sample used.

Creamery and Tester's License. Licenses authorizing their holders to buy milk or cream on the basis of the butterfat content were issued to 37 creameries, milk plants and ice cream manufacturers, in operation for one year or more; 3 such plants beginning operation this year; 6 cooperative buying and shipping agencies; 36 independent buyers; 951 cream buying stations in operation June 30 and 110 cream buying stations beginning operation since June 30, a total of 1143.

Thirty-one examinations for tester's license were held as follows: Louisville 6, Lexington 6, Bowling Green 6, Paducah 5, Owensboro 5, Cincinnati 1, Maysville 2. Notices for these examinations were sent to 902 persons and 562 applicants appeared. Of those examined 455, or 81 percent, made a passing grade. At this date, there are 1301 authorized testers in Kentucky. Of this number, 890 hold renewal licenses granted July 1, 1928, 337 are new operators licensed since that date, and 74 are operating on permits.

A total of 577 inspections have been made during the year. Based on these inspections, the operators were graded as follows: A, B and C grades, 423; D grade (probation) 135; E grade (second consecutive D) 19. Based upon these inspections, the licenses of 16 operators were temporarily revoked; 11 of this number were permanently revoked, 6 were continued on probation and 2 are pending action of the Examining Board.

Inspection has been made of 32,350 pieces of glassware, 111 of which were rejected as inaccurate.

The receipts for the year were $11,356.09, and the expenditures $8,623.15, distributed as follows:

Salaries	$5,949.54
Labor	507.84
Postage and stationery	290.90
Freight and express	2.09
Sundry and laboratory supplies	110.13
Travel	1,726.15
Furniture and fixtures	18.50
Contingent	18.00
Total	$8,623.15

Feed Control. The results for 1928 show an increase in every phase of the work over any previous year. A spirit of cooperation has been manifested by the manufacturer, distributor and feeder alike.

During the year, in round numbers, 325,000 tons of feed, not including whole grains and roughages, were consumed in the state, an increase of from 60,000 to 65,000 tons over 1927. Of this amount over 70 percent was imported from other states while less than 30 percent was produced within the state. Wherever possible farmers are being encouraged to increase the production of crops that can be converted into feeds and used in their community, so as to eliminate the necessity of importing feeds from other states or feed centers located at such distance that freight costs become an item of considerable expense. This practice is being followed in several localities of the state.

For the year, 1009 samples have been analyzed. Forty-one state cases and ten federal cases have been reported for prosecution.

Fertilizer Control. The registration of fertilizers totaled 724 brands, from nearly all of which samples were analyzed. In addition, analyses were made of 7743 samples collected by the official inspectors or sent in by individuals. Tags printed for the various manufacturers numbered 2,568,000.

Public Service Laboratories. The work in the bacteriological laboratory has shown a decided increase both in scope and number of specimens received, due apparently to the normal increase and to discontinuance of other laboratory services.

During the year, 1,138 physicians, public health nurses, hospitals, etc., have submitted work of public health nature. The records show that service has been rendered to every county in the state during the period covered by this report.

A total of 69,258 specimens has been examined for the year. Of these, 68,350 were handled in the bacteriological

laboratory and included examinations of blood and spinal fluids for the Wassermann and Kahn tests; agglutination tests for typhoid, paratyphoid, Malta fever, tularemia, etc.; microscopical and bacteriological examinations of specimens for tuberculosis, diphtheria, pneumonia, meningitis, malaria, gonorrhea, intestinal parasites, brains for rabies, etc.; and sanitary examinations of milks, ice cream, carbonated beverages, waters, canned foods and food for bacterial poisoning; 703 samples were examined in the food laboratory and consisted of chocolate milk, ice cream, meats, flour, canned fruits and vegetables, candy, etc.; 205 samples were handled in the drug laboratory and included poison investigations of miscellaneous nature, toxicological examinations of a medico-legal type, drugs, beverages, etc.

Seed and Nursery Inspection. A total of 3911 tests of seeds were made, of which 2729 samples were tested for germination, and 1182 samples for purity. Inspection was made of 99 nursery establishments. Twenty of these nurseries were found to be infested with the strawberry crown borer and fifteen with San Jose scale. Where San Jose scale was detected, the growers were required to destroy all plants evidently affected, and to fumigate nursery stock found infested with San Jose scale with hydrocyanic acid gas before selling.

Robinson Substation. In the spring 3300 trees were planted of the following species: Scotch, red, Jack, Slash, maritime, loblolly and Japanese red pines, Japanese larch, bald cypress and northern red oak. Altho part of the stock was received in poor condition, on the whole a very good stand was secured. The season was favorable for growth and the new and old plantations and natural reproduction all made good growth. A few black locust and white pine were raised from seed.

The first year's work in grading mountain mongrel poultry flocks was completed. Five pens of 12 pullets each were used in the test, and the average egg production was as follows:

Pen	Breed	Eggs Per Hen
A	Anconas	169
B	Mongrels	135
C	Rhode Island Reds	147
D	Mongrels	76
E	Mongrels	133

Pens A and B were mated to purebred Ancona cockerels out of 200-egg hens. Pens C and D were mated to purebred Rhode Island Red cockerels from hens with records above 200. Pen E was mated to mongrel males to serve as a control or check pen. During the second year of the experiment, the pullets raised from each pen replaced the hens that were in the pens the first year, thus pen A contains purebred Anconas, while pen B contains grade Anconas (one-half purebred); pen C contains purebred Rhode Island Reds, and pen D grade Reds. Pen E contains typical mountain mongrel stock. The grade pullets resemble closely their sires and it is evident that much was accomplished in improving physical characters, such as feather color, type and size with only one year of grading. This experiment will be continued thru several generations to measure the effects of grading on physical characteristics, egg production, rate of growth, size of fowl and color and size of egg.

The Third Annual Robinson Harvest Festival was held September 29-30. There were 1489 entries from thirteen counties.

Five health conferences with the County Health Unit were held, at which sixty-nine examinations were made of children under three years of age, and instructions given to the mothers on the proper feeding and care of children.

The young orchard of apples, peaches and cherries made excellent growth. The peach crop was destroyed by spring frosts. The vineyard produced a good crop of grapes.

Western Kentucky Substation. The work of the year has included several important property improvements; the purchase of additional acreage, which greatly improves the physical outlay and affords desirable space for needed expansion; initiation of several experimental projects and the continuation of projects already in progress.

The spring seeding of clovers and grasses on three 10-acre experimental fields proved very successful where limestone and acid phosphate were used; not so good where raw rock phosphate was used, and practically a total failure where no soil treatment was used. On 18 small pasture plots and 14 lespedeza plots outstanding results were obtained from spring seedings, depending upon soil treatments. The results from limestone and acid phosphate treatments on very poor soil have been most striking.

Corn was grown this year on a series of plots to which fertilizer and lime applications were made in the fall of 1926 when wheat was seeded. Clover was seeded in the spring of 1927 and was turned under in the latter part of April, 1928. The average yield of all check plots was 36.5 bushels per acre, while those treated with limestone and fertilizer yielded 53 bushels per acre.

In a study of the effect of different legumes in a 3-year rotation of corn, wheat and legume, grown on different soil treatments and disposed of in different ways, corn was grown this year on the legume series planted in the spring of 1927 and plowed in the latter part of April, 1928. The average yield of corn on the unfertilized checks which were seeded to a mixture of red and alsike clovers and lespedeza was 32 bushels per acre, while those that were treated with limestone and superphosphate and that had been seeded to clovers of various kinds, including lespedeza, was 53 bushels per acre. An interesting result is that the plots treated with superphosphate and seeded to lespedeza produced 34 bushels of corn, while a lot treated with limestone and superphosphate and seeded to lespedeza produced 50 bushels.

The second annual field day meeting was held August 23 with an attendance of 1200 persons from twenty-three western Kentucky counties and with representatives from seven other states.

New Projects. Cooperative experiments on methods of distribution of fertilizers for corn.

A study of the variation in the content of nitrogen and mineral elements in crops grown on various soil types under various methods of fertilization.

Orchard drainage.

A study of the relation of the potato leafhopper (*Empoasca fabae*) to clover and alfalfa failure.

The effect of artificially maintained soil reaction on nitrification and on the yield and composition of forced tomatoes and lettuce.

Study of land utilization in marginal and sub-marginal areas of Eastern Kentucky. (In cooperation with Bureau of Agricultural Economics, U. S. Department Agriculture)

Personnel.

A list of the Experiment Station staff is given on page 3 of this report. The appointments and resignations for the year follow:

Appointments:

Fordyce Ely, in charge of dairying. April 1.

Merton Oyler, assistant in rural life studies. July 16.

N. J. Howard, inspector, creamery license. July 1.

L. M. Caldwell, assistant, Western Kentucky Substation. July 1.

Z. L. Galloway, assistant in farm organization and management studies. July 1.

C. D. Phillips, assistant in marketing. September 1.

W. M. Insko, Jr., assistant in animal nutrition. August 21.

E. M. Emmert, assistant in horticulture, September 1.

W. Brooks Hamilton, assistant bacteriologist. October 15.

Wallace R. Roy, assistant chemist. October 15.

Resignations:

Lewis W. Taylor, assistant in poultry husbandry. August 20.

E. S. Hill, assistant chemist. June 30.

O. B. Jesness, head of the department of markets and rural finance. August 16.

K. R. Zent, assistant in marketing, September 1.

O. H. Pinney, assistant bacteriologist. September 30.

Transfers:

A. J. Olney, horticulturist, to acting head of the department of horticulture, June 21.

Library. The total accession of books in the Experiment Station library for the year 1928 amounts to 12,740, an addition of 405 volumes during the year. The number of periodicals subscribed for is 108 domestic, and 31 foreign.

Publications.

No.

Bulletins:

283. Marketing Kentucky Eggs. Dana G. Card. January 1928.

284. Commercial Feeds and Their Use in Kentucky in 1927. J. D. Turner, H. D. Spears, W. G. Terrell and L. V. Amburgey. May, 1928.

285. Marketing Kentucky Poultry. Dana G. Card. June, 1928.

286. Pathology and Bacteriology of the Reproductive Organs of Mares in Relation to Sterility. W. W. Dimock and P. R. Edwards. July, 1928.

287. The Marketing of Tobacco. O. B. Jesness. October, 1928.

288. The Cooperative Marketing of Tobacco. O. B. Jesness. October, 1928.

289. An Economic Study of Crops and Livestock in the Purchase Region of Kentucky. J. B. Hutson, W. G. Finn and Z. L. Galloway. November, 1928.

290. Analyses of Commercial Fertilizers. H. E. Curtis, H. R. Allen and Lelah Gault. December, 1928.

Circulars:

39. Acidosis of Pregnant Ewes: So-Called Pregnancy Disease of Sheep. W. W. Dimock, D. J. Healy and F. E. Hull. October, 1928.
40. Bacillary White Diarrhea. P. R. Edwards and F. E. Hull. November, 1928.

Reports:

Fortieth Annual Report of the Experiment Station—1927. Thomas Cooper.

Scientific Papers:

The proportion and significance of copper, iron, manganese and zinc in some mollusks and crustaceans J. S. McHargue. Transactions, Ky. Acad. Science, Vol. 2, 1928, pp. 46-52.

Dr. Robert Peter (Biographical sketch of his scientific achievements) J. S. McHargue. Journ. Chem. Educ. Vol. 5, No. 2, February, 1928, pp. 151-156.

Kentucky bluegrass—whence did it come? J. S. McHargue. Transactions, Ky. Acad. Science, Vol. 2, 1928, pp. 179-190.

The relation of copper to the hemoglobin content of rat blood. J. S. McHargue, D. J. Healy and E. S. Hill. Journ. Biol. Chem., Vol. 78, No. 3, August, 1928, pp. 637-641.

The effect of a manganese deficiency on the sugarcane plant and its relationship to Pahala blight of sugarcane. H. A. Lee and J. S. McHargue. Phytopathology, Vol. 18, No. 9, September 9, 1928, pp. 775-786.

A metal-free cage for metabolism experiments with small animals. J. S. McHargue. Paper presented before the Division of Biological Chemistry of the Am. Chem. Soc., Swampscott, Mass., September 10-15, 1928

Report of the Associate Referee on the less common elements in soils and plants. J. S. McHargue. Presented at the 44th annual convention of Assoc. Official Agr'l Chemists, Washington, D. C., October 29-31, 1928.

Oxidation of sulfur in limed and unlimed soils. O. M. Shedd. Soil Science, Vol. 26, No. 2, August, 1928, pp. 93-105.

The relative utilization of different calcium compounds by hens in the production of eggs. G. D. Buckner, J. Holmes Martin and A. M. Peter. Journ. Agr'l Research, Vol. 36, No. 3, February 1, 1928, pp. 263-268.

A normal sheep urinalysis. D. J. Healy, J. F. Bullard and H. D. Spears. Journ. Am. Vet. Med. Assoc., Vol. 73, No. 1, May, 1928, pp. 87-91.

The use of individual branches of a peach tree to show comparative results on time of thinning. A. J. Olney and C. S. Waltman. Transactions, Ky. State Hort. Soc. for 1928, pp. 65-68.

Comparative agglutinating properties of different strains of *Bacterium abortus* Bang. E. S. Good, W. W. Dimock and Amanda H. Harms. Journ. Am. Vet. Med. Assoc., Vol. 73, June, 1928, pp. 223-231.

The physical basis of sterility. W. S. Anderson. Proceedings, Am. Soc. An. Production for 1928.

Land values in relation to animal production. W. S. Anderson. Proceedings, Assoc. Southern Agr'l Workers for 1928, pp. 168-171.

Non-breeders; males should be bought with a guarantee. W. S. Anderson. The Cattleman, May, 1928.

Some objectives in animal husbandry. E. S. Good Proceedings, Assoc. Southern Agr'l Workers for 1928, pp. 120-122.

Acidosis of pregnant ewes: so-called pregnancy disease of sheep. W. W. Dimock, D. J. Healy and J. F. Bullard. Journ. Am. Vet. Med. Assoc., Vol. 72, No. 4, January, 1928, pp. 511-516.

Diminished plasma buffer value in pregnancy disease of ewes. D. J. Healy and F. E. Hull. Cornell Vet., 13, January, 1928, pp. 73-75.

Mineral metabolism during pregnancy. D. J. Healy and F. E. Hull. Ky. Acad. Science, May, 1928.

Canebreaks of Kentucky in prehistoric time and the importance of cane as a forage plant. J. S. McHargue, E. S. Hill and W. A. Anderson. Ky. Acad. Science, May, 1928.

Bacterium viscosum equi a factor in joint-ill and septicemia in foals. W. W. Dimock, P. R. Edwards and J. F. Bullard. Journ. Am. Vet. Med. Assoc., Vol. 73, No. 2, June, 1928, pp. 163-172.

The relation of encapsulated bacilli found in metritis in mares to encapsulated bacilli from human sources. P. R. Edwards. Journ. Bact. Vol. 15, No. 4, April, 1928, pp. 245-266.

Fermentation of maltose by Bacterium pullorum. P. R. Edwards. Journ. Bact., Vol. 15, No. 4, April, 1928, pp. 235-243.

The soils problem in Kentucky. George Roberts. Transactions, Ky. State Hort. Soc. for 1928, pp. 44-54.

The Latham raspberry. A. J. Olney. Transactions, Ky. State Hort. Soc. for 1928, pp. 74-75.

Recent observations on blight control. W. D. Valleau. Transactions, Ky. State Hort. Soc. for 1928, pp. 127-131.

Principles of structure for apple storage houses. J. B. Kelley. Transactions, Ky. State Hort. Soc. for 1928, pp. 153-165.

Recent recommendations in insect and disease control. W. W. Magill. Transaction, Ky. State Hort. Soc. for 1928, pp. 119-121.

Weed control and the potato virus problem. W. D. Valleau and E. M. Johnson. Am. Potato Journ., Vol. 5, Sept., 1928, pp. 257-259.

Factors influencing thickness of shell. L. W. Taylor and J. Holmes Martin. Poultry Science, Vol. 8, No. 1, pp. 39-44, 1928.

The accuracy of the agglutination test in the diagnosis of bacillary white diarrhea. P. R. Edwards and F. E. Hull. Journ. Am. Vet. Med. Assoc., Vol. 73, No 7, Nov., 1928, pp. 839-841.

FINANCIAL STATEMENT

In Account with the United States Appropriations, 1927-1928.

	Hatch Fund	Adams Fund	Purnell Fund
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1928, under acts of Congress approved March 2, 1887 (Hatch Fund), March 16, 1906 (Adams Fund), and February 24, 1925 (Purnell Fund)	$15,000.00	$15,000.00	$40,000.00
Expenditures:			
By salaires	14,835.13	14,667.93	33,874.07
Labor		156.09	1,819.89
Stationery and office supplies			119.29
Scientific supplies, consumable		119.93	415.61
Feeding stuffs			999.85
Sundry supplies		24.58	105.12
Fertilizers			
Communication service			50.50
Travel expenses	80.61		2,027.70
Transportation of things		7.65	25.74
Publications	84.26		225.73
Heat, light, water and power			
Furniture, furnishings, fixtures			16.10
Library			149.81
Scientific equipment		23.82	170.59
Livestock			
Tools, machinery and appliances			
Buildings and land			
Contingent expenses			
Balance			
Total	$15,000.00	$15,000.00	$40,000.00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year ended June 30, 1928; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was none on the Hatch Fund and none on the Adams Fund and none on the Purnell Fund; that the receipts for the year from the Treasurer of the United States were $15,000.00 under the act of Congress of March 2, 1887, $15,000.00 under the act of Congress of March 16, 1906, and $40,000.00 under the act of Congress of February 24, 1925, and the corresponding disbursements $15,000.00, $15,000.00, and $40,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, leaving balance of $ none, $ none, $ none, respectively.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

Signed:

LOUIS E. HILLENMEYER,
WELLINGTON PATRICK,
Auditors.

Seal of
Institution.

Attest:
MARGARET WILLIAMS,
Custodian of the Seal

METEOROLOGICAL SUMMARIES

For the Year 1928

Compiled from the Records of the U. S. Weather Bureau Station, Lexington, Ky.

ANNUAL METEOROLOGICAL SUMMARY

Month	Temperature. Degrees Fahrenheit							Relative Humidity Per cent 7 a. m.	Precipitation, in Inches				Per cent of Sunshine	Wind					Number of Days											
	Mean			Extreme												Maximum For 5 mins.										Max. Temp.		Min. Temp.	
	Maximum	Minimum	Monthly	Maximum	Date	Minimum	Date		Total	Maximum in 24 hours	Date	Total Snowfall, Inches		Average Hourly Velocity	Prevailing Direction	Velocity	Direction	Date	Gales, 33 miles per hour or over	Clear	Partly Cloudy	Cloudy	Precipitation of .01 inch or more	With trace of snow or more	Thunderstorms	Dense fog	90 deg. or above	Freezing or below	Freezing or below	Zero or below
January	40.1	25.1	42.6	67	16	—4	2	83	2.68	1.37	18-19	2.4	49	13.4	SW	52	W	24	4	12	7	12	9	6	1	1	0	9	20	3
February	42.8	28.2	35.5	64	4	11	26	80	2.30	0.70	22	1.6	38	13.2	SW	35	NW	18	2	11	2	16	11	5	0	1	0	4	19	0
March	51.5	32.7	42.1	77	23	18	5	77	2.67	1.05	29-30	5.1	38	12.8	SW	42	NW	26	3	10	7	14	12	6	3	0	0	2	19	0
April	59.6	41.7	50.6	77	2	28	15	71	2.76	1.01	13-14	T	41	14.1	SW	46	NW	14	7	7	13	19	12	2	1	0	0	0	5	0
May	71.5	52.8	62.2	85	3	38	8	69	2.12	1.24	17-18	0	62	11.2	SW	26	NW	1	0	15	10	6	7	0	3	0	0	0	0	0
June	75.0	59.4	67.2	85	19	50	6	85	10.62	5.50	28-29	0	32	11.8	SW	36	NE	19	3	4	13	13	21	0	11	1	0	0	0	0
July	83.9	67.7	75.8	90	21	58	29	82	5.16	2.56	12-13	0	66	8.0	SW	28	SW	5	0	20	8	3	10	0	10	0	0	0	0	0
August	82.8	67.5	75.2	90	9	60	13	88	4.30	1.50	30-31	0	48	8.5	SW	31	SW	14	0	9	15	7	12	0	9	0	1	0	0	0
September	73.5	55.0	64.2	88	14	36	24	78	0.71	0.36	29	0	70	9.4	SW	31	NW	25	0	20	7	3	3	0	0	1	0	0	0	0
October	69.7	52.2	61.0	85	13	30	13	79	2.69	1.19	22-23	0	63	11.6	SW	30	SW	17	0	17	8	6	9	0	4	4	0	0	1	0
November	52.1	37.7	44.9	73	17	17	26	84	3.79	1.64	29-30	0.4	37	12.3	SW	38	SW	21	2	7	7	16	16	5	0	4	0	1	9	0
December	46.7	32.1	39.4	60	28	14	21	76	1.92	0.79	16-17	T	54	11 1	SW	40	NW	17	2	14	6	11	10	6	0	0	0	3	16	0
The Year	62.4	46.0	54.2	90	Aug. 9	—4	Jan. 2	79	41.72	5.50	June 28-29	9.5	50	11.4	SW	52	W	Jan. 24	23	146	103	117	132	30	42	12	1	19	89	3

MONTHLY AND ANNUAL MEAN TEMPERATURE

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1872											37	27	
1873	30	35	42	53	66	74	75	74	67	53	40	39	54.0
1874	36	38	44	46	66	77	78	75	71	57	45	38	56.0
1875	27	29	42	49	64	72	76	71	64	52	43	43	52.7
1876	41	39	41	52	65	72	77						
1887											44	35	
1888	31	36	41	56	63	72	76	74	63	51	46	37	54.0
1889	37	32	46	55	63	69	75	72	65	52	43	50	55.0
1890	44	45	39	56	63	77	76	71	67	56	49	37	56.6
1891	37	41	40	57	62	76	73	73	72	55	43	43	56.0
1892	28	41	39	54	63	76	75	75	68	57	41	33	54.1
1893	23	36	43	57	61	72	79	74	70	57	43	37	54.4
1894	38	34	49	54	62	75	76	76	71	58	41	37	55.9
1895	28	23	43	56	62	75	73	76	73	52	45	37	53.7
1896	34	35	38	62	71	72	75	75	67	54	48	38	55.9
1897	30	37	48	53	59	72	76	74	72	64	46	37	55.7
1898	38	36	49	50	65	74	76	76	72	56	43	33	55.8
1899	34	24	42	56	67	75	77	77	68	61	48	33	55.1
1900	36	31	39	55	66	72	77	79	73	65	45	37	56.3
1901	34	29	44	49	63	74	80	74	67	58	40	31	53.6
1902	32	25	45	53	68	71	77	74	67	59	53	34	54.8
1903	32	36	50	53	68	68	77	74	70	57	40	28	54.4
1904	30	31	46	48	64	72	74	74	69	57	44	34	53.5
1905	24	25	49	54	66	72	75	74	68	55	44	35	53.5
1906	37	32	36	57	64	72	74	76	71	55	45	36	54.5
1907	40	32	52	45	59	69	76	73	68	53	42	37	53.8
1908	33	33	50	55	65	72	76	75	72	58	48	38	56.1
1909	37	41	43	54	62	73	73	74	66	53	53	28	54.6
1910	32	31	54	54	59	69	75	73	70	60	40	29	53.7
1911	38	40	43	52	70	74	76	76	72	58	40	41	56.6
1912	23	28	39	57	65	69	75	72	70	59	44	36	53.1
1913	42	33	44	53	65	73	78	77	69	56	49	38	56.5
1914	37	29	40	54	66	76	78	75	67	59	46	30	54.6
1915	32	40	36	59	62	70	74	70	70	60	49	36	54.8
1916	40	33	41	52	67	69	78	76	67	58	47	34	55.2
1917	35	32	44	54	57	70	74	74	67	50	44	25	52.3
1918	20	38	49	52	69	72	73	79	62	61	44	43	55.2
1919	37	36	46	54	62	76	79	74	72	64	45	31	56.3
1920	30	33	45	50	62	71	74	72	70	62	43	36	54.1
1921	37	38	55	58	65	76	80	75	73	57	48	39	58.4
1922	33	38	47	57	68	75	76	75	73	61	47	39	57.3
1923	39	32	43	53	63	74	77	74	69	56	45	45	55.8
1924	30	33	39	55	58	73	73	75	64	62	45	34	53.5
1925	33	43	47	59	60	76	75	76	76	50	43	32	55.8
1926	32	37	37	49	65	69	77	76	72	57	41	35	53.8
1927	33	43	48	55	63	69	75	70	72	61	50	35	56.2
1928	33	36	42	51	62	67	76	75	64	61	45	39	54.2

TEMPERATURE EXTREMES

Month	Highest	Year	Day	Lowest	Year	Day
January	72	1906	21	—14	1918	12
February	75	1918	28	—20	1899	13
March	85	1910	24	1	1873	4
April	90	1925	24	15	1875	18
May	93	1911	28	30	1876	1
June	99	1914	27	40	1910	3
July	102	1901	22	51	1891	9
August	100	1918	6	46	1915	31
September	99	1925	9	32	1899	30
October	89	1919	2	21	1925	29
November	78	1895	7	2	1872	29
December	71	1875	31	— 9	1917	10

MONTHLY AND ANNUAL PRECIPITATION

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1872											1.21	3.30	
1873	2.53	4.05	3.73	2.89	6.05	4.49	3.37	2.94	1.60	5.47	1.92	4.48	43.52
1874	5.41	4.89	5.90	6.81	0.79	3.55	6.26	1.57	2.89	0.92	4.27	3.83	47.09
1875	2.61	3.12	6.18	2.06	2.43	4.16	11.24	0.62	1.72	2.37	5.87	3.68	46.06
1876	6.06	1.66	3.63	4.20	2.16	4.13	3.84						
1887											3.02	2.71	
1888	4.39	2.93	5.82	3.17	3.29	2.97	4.21	8.76	1.22	3.02	5.15	1.88	46.81
1889	5.66	1.78	1.63	1.52	3.53	3.49	5.82	1.15	6.79	3.06	5.34	1.73	41.50
1890	5.34	8.13	9.91	3.59	4.71	7.43	3.14	7.32	1.82	2.38	3.54	4.05	61.36
1891	4.70	4.36	7.63	1.85	1.17	5.33	3.23	6.48	1.26	1.33	5.38	2.82	45.51
1892	2.35	3.10	4.01	6.57	5.32	3.81	6.22	3.28	4.10	0.45	3.72	3.03	45.96
1893	2.10	4.44	3.30	5.81	3.88	4.24	3.11	1.86	2.25	5.59	3.36	2.61	42.55
1894	3.58	3.33	2.13	4.19	3.81	4.44	0.87	3.67	4.05	1.40	1.38	3.45	36.32
1895	5.60	0.52	2.79	3.17	4.05	2.93	5.07	1.56	0.33	1.28	2.52	5.50	35.32
1896	1.25	3.15	5.41	0.40	3.20	3.74	10.39	3.37	4.25	1.27	4.30	2.56	43.29
1897	2.59	6.33	6.55	5.80	4.48	4.77	4.34	3.21	0.80	0.38	4.83	5.11	49.19
1898	9.56	2.20	8.18	3.29	6.13	7.94	5.72	2.99	3.55	5.27	2.89	2.80	60.52
1899	6.69	2.84	8.61	2.16	3.63	2.55	0.97	4.18	1.90	2.09	1.70	2.92	40.24
1900	2.13	3.17	1.98	1.23	3.54	2.19	2.80	5.75	1.85	0.79	6.38	1.86	33.67
1901	1.49	0.62	2.23	4.52	2.67	3.70	2.61	3.74	2.18	1.33	1.73	3.50	30.32
1902	4.77	0.90	2.92	1.27	2.43	5.19	2.33	1.89	2.60	2.11	3.09	6.60	36.10
1903	1.68	6.16	3.24	3.29	1.75	2.71	2.62	1.49	0.81	2.12	2.84	1.99	30.70
1904	1.92	2.38	4.75	3.08	2.60	2.51	3.13	2.44	1.71	0.57	0.53	3.10	28.72
1905	2.04	2.13	5.87	2.87	5.54	3.31	4.94	4.11	3.20	3.45	3.58	4.13	45.17
1906	2.29	1.84	6.45	1.11	3.15	4.68	3.89	4.92	5.03	0.74	3.95	4.54	42.59
1907	9.06	1.89	4.13	1.83	3.89	3.65	4.42	2.07	2.72	2.76	2.67	2.28	41.37
1908	1.85	4.81	8.17	4.99	4.20	2.12	3.60	2.98	0.38	0.72	1.65	2.13	37.60
1909	3.35	6.86	3.97	6.72	4.15	5.41	5.98	1.26	4.88	2.05	1.96	2.77	49.36
1910	4.46	4.11	0.46	4.22	6.24	5.92	7.66	4.15	7.93	1.67	1.72	2.81	51.34
1911	2.44	2.21	2.31	4.46	1.07	3.01	0.92	2.84	4.37	3.67	3.84	6.20	37.34
1912	1.78	2.50	4.36	6.89	5.11	2.15	4.70	3.23	2.09	0.51	1.02	3.66	38.00
1913	10.35	2.61	6.04	2.41	4.32	3.29	2.43	1.00	1.76	3.40	4.00	2.74	44.35
1914	2.50	3.87	2.24	2.23	1.65	4.77	2.63	4.69	1.82	5.32	1.62	4.40	37.74
1915	4.38	1.12	1.49	0.65	7.23	3.20	5.72	6.03	3.74	0.81	3.90	6.67	44.94
1916	5.65	3.40	3.30	1.01	2.92	5.33	1.72	2.34	2.75	2.04	1.25	3.63	35.34
1917	5.67	2.12	5.48	3.97	3.51	3.54	2.80	1.94	2.46	2.36	1.03	1.97	36.85
1918	4.46	1.92	1.55	2.09	3.13	3.61	2.01	2.68	1.41	4.57	2.24	4.83	35.50
1919	2.48	1.61	3.71	3.51	6.38	4.49	2.28	2.39	1.12	7.95	8.50	6.70	51.12
1920	5.26	2.11	4.62	6.42	2.51	2.39	1.73	6.71	4.88	2.75	2.22	1.40	43.00
1921	3.24	2.62	5.06	3.28	1.60	2.16	1.04	3.88	5.10	2.46	6.89	5.74	43.07
1922	1.87	3.12	7.75	4.46	3.10	2.44	2.13	2.20	5.99	1.25	0.88	5.67	40.86
1923	6.63	4.40	4.65	5.43	1.66	3.55	5.01	4.02	1.51	0.56	2.71	6.50	46.63
1924	5.00	2.60	2.42	3.75	3.04	4.04	2.77	2.28	3.89	0.11	1.32	5.59	36.81
1925	3.41	3.03	3.45	2.49	3.56	3.96	3.63	1.15	1.70	5.83	4.52	0.80	37.52
1926	4.43	2.27	2.52	1.54	2.06	2.78	5.95	7.03	4.04	7.46	3.21	4.32	47.61
1927	6.53	1.87	5.17	3.89	5.76	2.14	2.95	2.09	2.29	1.65	4.88	3.64	42.86
1928	2.68	2.30	2.67	2.76	2.12	10.62	5.16	4.30	0.71	2.69	3.79	1.92	41.72

EXTREMES OF PRECIPITATION AND WIND

Month	PRECIPITATION			WIND			
	Greatest in 24 hrs.	Year	Day	Max. Vel.†	Dir.	Year	Day
January	3.50	1913	11	52	w	1928	24
February	3.04	1909	23-24	49	sw	1890*	25
March	3.61	1913	25-26	55	sw	1919	17
April	3.24	1909	29-30	52	sw	1909*	29
May	2.61	1898	6-7	52	sw	1924	24
June	5.50	1928	28-29	49	n	1890*	29
July	4.02	1875	11-12	47	nw	1915	30
August	2.98	1915	1-2	58	s	1918	6
September	5.45	1922	3	55	w	1889	8
October	2.32	1893	3-4	41	nw	1904*	21
November	3.95	1919	[illegible]	51	s	1895*	26
December	3.63	1919	6	[illegible]	sw	1895*	26

*Also in subsequent years. †Basis [illegible]-cup anemometer.